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## Program Overview

Metro Wastewater Reclamation District (Metro District) applies biosolids to their properties near Deer Trail, Colorado. These biosolids applications could affect the quality of water in alluvial and bedrock aquifers, streambed sediments, soils, and crops. Water quality can be directly affected through:

- Contaminated recharge water, or
- Infiltration of water through contaminated soils or sediments (remobilization).

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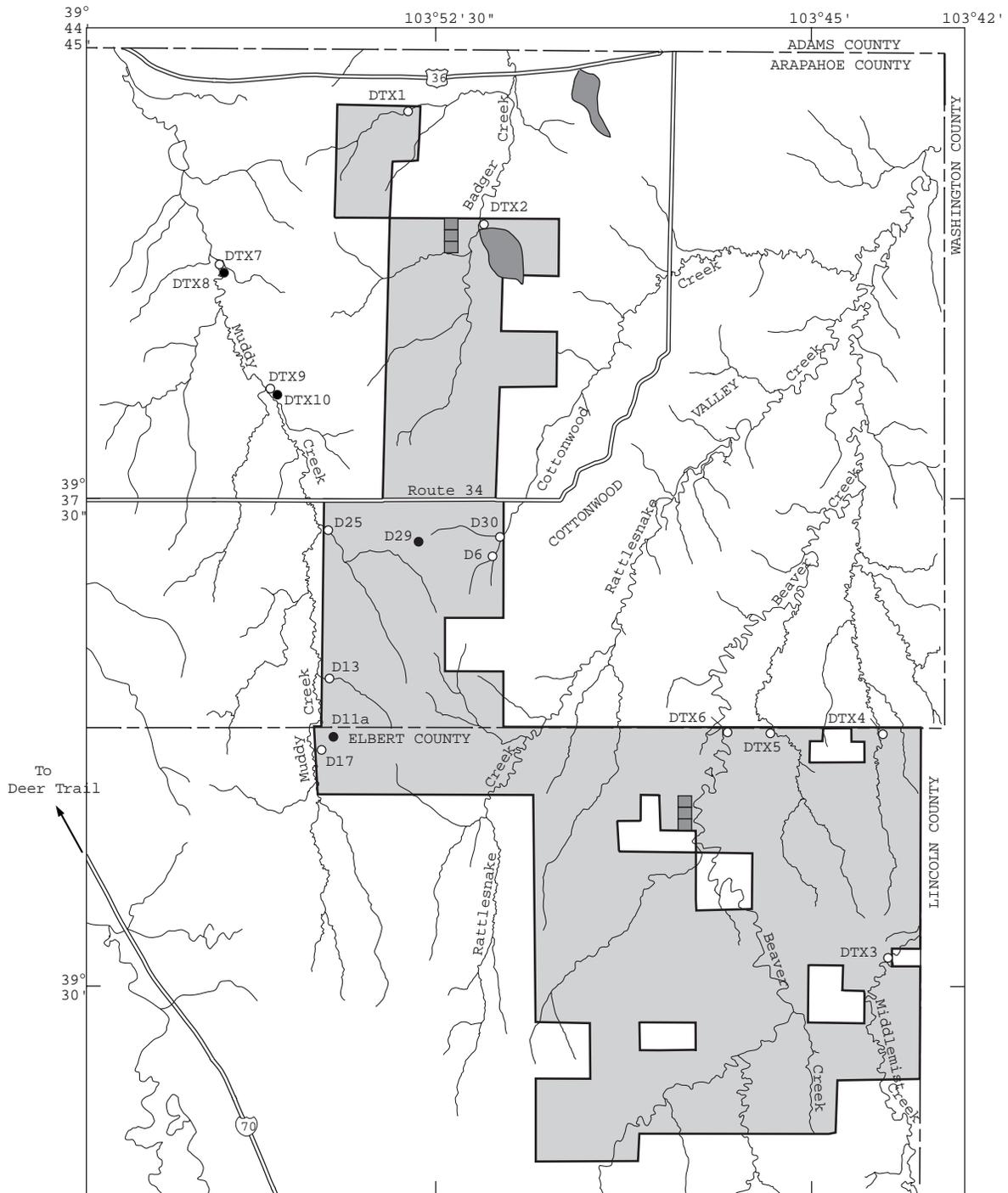
## USGS

The U.S. Geological Survey is a science organization that provides the Nation with reliable, impartial information to describe and understand the Earth. The USGS home page: <http://www.usgs.gov>

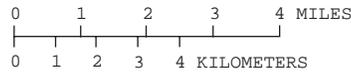
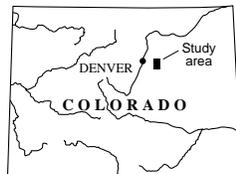
How can I get a copy of this Quarterly Report, get on the mailing list or have the mailing list corrected? Contact Tracy Yager. See page 8.



**USGS sampled soils in August 1999**



To Deer Trail



EXPLANATION

- Metro Wastewater Reclamation District property
- Streambed-sediment sampling area
- DTX1 ○ USGS alluvial monitoring well
- D29 ● USGS bedrock monitoring well
- Soil-sampling area

**USGS Expanded Monitoring Program sites and Metro District's biosolids-application properties near Deer Trail, Colorado**

## Program Overview

*Continued from page 1*

Water quality can be indirectly affected through:

- Plowing that mobilizes or changes subsurface chemical constituents, or
- Contributions to natural processes such as nitrification.

Contaminated ground water or surface water could contaminate:

- Other aquifers, such as bedrock water-supply aquifers or alluvial aquifers,
- Other surface-water bodies (ponds or streams), or
- Streambed sediments.

Biosolids must meet metals and radioactivity regulations, or else agronomic loading rates will be incorrect and soils could be overloaded. Soil quality could either be improved by biosolids applications through increased nutrients and organic matter, or degraded through an overload of nutrients or metals.

The U.S. Geological Survey (USGS) has designed and begun a new monitoring program to address concerns from a stakeholder group about the biosolids and the quality of the environment in the vicinity of the biosolids-application areas. The new USGS monitoring program near Deer Trail is referred to as the "USGS Expanded Monitoring Program" and began in January 1999.

This monitoring program is distinct from, but builds on, another

USGS program that monitored shallow ground-water quality on the Metro District Central Farm from 1993-1998. The new program (1999-2005) considers environmental-quality issues for shallow and deep ground water, surface water (bed sediments), soils, crops, and the biosolids. The new expanded monitoring program includes all three Metro District properties (North, Central, and South Farms) and related private-property locations. Both programs, however, use USGS and Metro District funds. In addition, the new monitoring program also uses funds from the North Kiowa Bijou Ground Water Management District. Both programs are designed, carried out, and interpreted independently by USGS, and quality-assured USGS data and reports will be released to the public and the Metro District at the same time. By definition and design, all USGS monitoring programs are independent and unbiased.

The objectives of the new Expanded Monitoring Program are to:

- (1) Evaluate the combined effects of biosolids applications, land use, and natural processes on alluvial aquifers, the bedrock aquifer, streambed sediments, soils, and crops by comparing chemical data to

- State or Federal regulatory limits,
- Data from a site where biosolids are not applied (a control site), or

- Earlier data from the same site (trends).

(2) Monitor biosolids for metals and radioactivity, and compare the concentrations with regulatory limits.  
(3) Determine the aquifer hydrology in this area.

The approach is unique for each component of the Expanded Monitoring Program. However, appropriate USGS methods and technologies will be applied to each component.

Quarterly reports such as this one will be distributed to the stakeholders and other concerned people, as well as available to the general public on the internet (<http://webserver.cr.usgs.gov>).

Each quarterly report will summarize progress from the previous quarter and plans for the current quarter; chemical data will be included every other quarter. A USGS report will be prepared annually and made available after each year of the monitoring program: the reports will include data for that year, any interpretations for that year, and statistical analysis for the data to date. A comprehensive USGS report will be prepared and available after five years of monitoring that includes complete statistical analyses and interpretations. In addition, the USGS will meet with the stakeholders once a year to discuss the Expanded Monitoring Program results and to consider possible changes to the Expanded Monitoring Program.

## Questions & Answers

**Q:** Some stakeholders are concerned that contaminated Lowry Landfill ground water will contaminate the Deer Trail site through biosolids applications. How is USGS involved at the Lowry Landfill superfund site?

**A:** On July 7, 1999, the U.S. Environmental Protection Agency (USEPA) Lowry Project Manager came to the USGS ground-water sampling Open House at the Deer Trail site. Subsequently, USGS was asked to evaluate radionuclide contamination at the Lowry Landfill superfund site, as well as to sample influent and effluent of the new Lowry Landfill onsite water treatment plant before the water is transferred to the Metro District for further treatment. On October 1, 1999, USGS began reviewing the existing data and interpretations from the Lowry Landfill, as well as attending meetings and reviewing other information as requested by USEPA. USGS is currently working on an approach for sampling the ground-water influent and effluent of the new onsite water treatment plant while that plant is constructed. Please contact Tracy Yager for more information.

## Alluvial Ground Water

### Approach

Six new monitoring wells will be installed near the Metro District property boundaries in the major alluvial aquifers. These six wells plus five existing USGS monitoring wells will be sampled approximately quarterly for full inorganic chemistry and annually for radioactivity. Data will be reviewed and statistically tested for exceedance of regulations and trends.

### Progress Last Quarter (July–September 1999)

Ground-water levels were measured the first week of July. Ground water was sampled for chemistry (including radionuclides) July 6–12, 1999. A ground-water sampling “Open House” was held July 8, 1999, at the DTX8 site. Instrumentation was installed at wells D25, DTX2, and DTX5 to monitor and continuously record rainfall, ground-water levels, and air and water temperature at these sites. These data can be viewed on the Internet (<http://nwis-colo.cr.usgs.gov/>). Ground-water data were compiled, reviewed, and released in the previous Quarterly Report (September 1999). USGS presented the status and results from this program at the first annual stakeholders meeting held July 15, 1999, in Kiowa, Colorado.

### Plans for the Current Quarter (October–December 1999)

Ground-water levels will be measured the first week of each month. Ground water will be sampled in mid-November, weather

permitting. The three instrumentation sites (including rain gages and continuous recorders) will be checked and calibrated this quarter; data may be made available to the public on the Internet if everything functions correctly. Data will be compiled and reviewed.

## Bedrock Ground Water

### Approach

A structure map of the base of the bedrock aquifer will be compiled and used to determine locations for two sets of new, paired wells (one alluvial well and one nearby dual-completion bedrock well comprise each pair). The well pairs will be installed where both the Muddy Creek alluvial aquifer and the Laramie-Fox Hills aquifer

are present (along the margin of the bedrock aquifer) near the Metro District properties. Water-level data from each well pair will be used to determine aquifer hydrology and interaction at those two locations. The two new bedrock wells, along with an existing USGS bedrock well, will be sampled approximately quarterly for full inorganic chemistry and annually for radioactivity. Data will be reviewed and statistically tested for exceedance of regulations and trends.

### Progress Last Quarter (July–September 1999)

Ground-water levels were measured the first week of July. Ground water was sampled for chemistry

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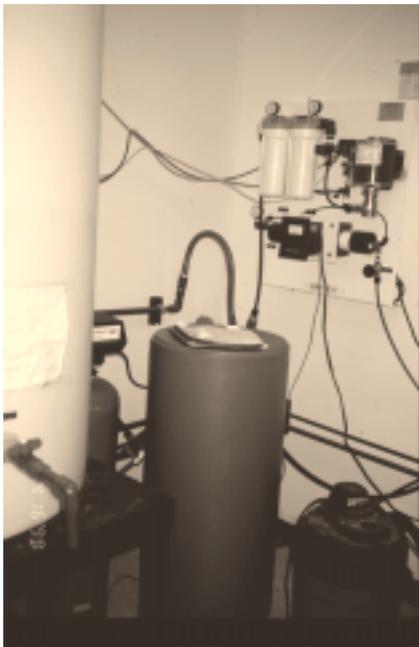


**Instrumentation was installed at USGS monitoring wells D25, DTX2, and DTX5 during the summer. The instrumentation will monitor and continuously record rainfall, ground-water levels, and air and water temperature at these sites. These data can be viewed on the Internet.**

## **Bedrock Ground Water**

*Continued from page 4*

(including radionuclides) July 6-12, 1999. A ground-water sampling “Open House” was held July 8, 1999, at the DTX8 site. Ground-water data were compiled, reviewed, and released in the previous Quarterly Report (September 1999). USGS presented the status and results from this program at the first annual stakeholders meeting held July 15, 1999, in Kiowa, Colorado. USGS found a fossilized turtle skull on the Metro property while field checking the structure map. The fossil was cleaned by (and is currently at) the Denver Museum of Natural History.



***A water-treatment system at USGS produces the deionized water used to clean the sampling equipment***

Plans for the Current Quarter (October-December 1999)

Ground-water levels will be measured the first week of each month. Ground-water sampling will take place in mid-November, weather permitting. Data will be compiled and reviewed.



***USGS streambed-sediment samples are mixed (by stirring) and sieved before analysis at the USGS laboratory***



***“Clean hands” procedures and equipment are used to process the streambed-sediment samples to prevent trace-element contamination***

## **Surface-Water Sediments**

### **Approach**

Surface-water contamination is a concern for the stakeholders, but

streams flow off the Metro District properties only during runoff when surface-water sampling is impractical. Therefore, possible surface-water contamination from metals will be evaluated by sampling streambed sediments soon after storms.

*Continued on page 6*

## Surface-Water Sediments

*Continued from page 5*

Two small drainage basins will be selected for similar characteristics but different land use—one drainage in a biosolids-application field and another drainage in a farmed field (not on the Metro District properties) that does not receive biosolids. A downstream location in each of the two drainage basins will be sampled after the same storms, three to four times per year for inorganic constituents (including metals, total nitrogen, and total phosphorous) and organic carbon, and one time per year for radioactive constituents. Data will be reviewed and statistically tested to determine if concentrations are significantly different between the two drainage basins.

### Progress Last Quarter (July–September 1999)

USGS presented the status and approach for this program at the first annual stakeholders meeting held July 15, 1999, in Kiowa, Colorado. A pair of surface-water drainage basins were selected for sampling. Equipment was prepared for sampling. The site was carefully monitored for runoff-producing rainfall. Several sampling trips were made to the site, but only a partial sample could be obtained from one of the two sites.

### Plans for Current Quarter (October–December 1999)

Sampling may take place, depending on the weather. USGS will review the approach for remote monitoring of rainfall and sampling after rainfall. A new staffing plan will be made to ensure USGS

obtains the necessary samples next spring, summer, or fall.

## Biosolids

### Approach

Biosolids samples will be taken as a 24-hour composite from the Metro District plant and analyzed by USGS. Biosolids will be sampled and analyzed once each quarter during most of the program, and once each month for six months when the Lowry landfill water transfer begins. Data will be reviewed and compared to Federal regulatory limits.

### Progress Last Quarter (July–September 1999)

The third quarterly composite sample of biosolids was received

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**USGS, Metro District, and Denver Museum of Natural History staff visited the Metro Central Farm near Deer Trail in July 1999 to look for the fossilized turtle body to match the fossilized turtle skull found at the site by USGS earlier this year**

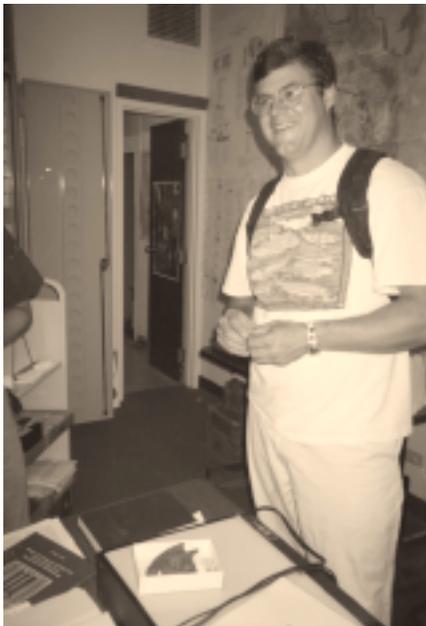
## Biosolids

*Continued from page 6*

from the Metro District on September 1, 1999. The sample was a 24-hour composite from the conveyor belt at the Metro facility. The material was placed in two acid-washed, one-gallon plastic bottles and transported to the USGS in Lakewood. There, the sample was air-dried prior to grinding to less than 150 micrometers. Biosolids data were compiled, reviewed, and released in the previous Quarterly Report (September 1999).

### Plans for Current Quarter (October-December 1999)

Chemical analysis of the June and September biosolids samples will be completed. The fourth quarterly sample of biosolids material will be collected, dried, and prepared for analysis. Data will be compiled and reviewed.



**Kirk Johnson, Curator of Paleontology at the Denver Museum of Natural History, and the fossilized turtle skull found near Deer Trail (see pages 5-6)**

## Soils

### Approach

One site will be selected for characterizing and monitoring the chemical composition of soil on the Metro District property in Arapahoe County and one site will be selected on the Metro District property in Elbert County. Each site will consist of three 20-acre (933 feet by 933 feet) fields separated by 100-foot buffer zones. The center 20-acre field at each site will have biosolids applied after the initial soil sampling. The other two 20-acre fields at each site will not have biosolids applied and will be used as “control” fields to monitor the natural variability of soil composition for the duration of the study. All three 20-acre fields at each site will be farmed in the normal fashion and have crops planted and harvested. Soils from each of the six fields will be sampled before biosolids are applied to the two center fields and then again after each harvest. Samples will be analyzed for arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, plutonium, and gross alpha and beta activity. Data will be examined after 5 years to determine if concentration has changed with time.

### Progress Last Quarter (July-September 1999)

Sampling sites were finalized; biosolids have never been applied to either site. The sites were sampled August 25-26, 1999, to determine the average composition of the top 12 inches of soil in each of the six 20-acre fields. From each of the center (biosolids-applied) fields, 36 subsamples were collected according to a grid. From each of the control fields, 30 subsamples were collected according to a grid. The subsamples were then dried at the USGS laboratories.

### Plans for Current Quarter (October-December 1999)

Soil subsamples will be sieved, ground, then composited for each 20-acre field. The composited samples representing each of the six fields will be submitted to USGS laboratories for analysis.

## Crops

### Approach

Crops from each of the six 20-acre (soil monitoring) fields will be chemically analyzed after harvest. Analyses will include arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc.

### Progress Last Quarter (July-September 1999)

No activity scheduled until harvesting of the first crop grown on the soil-monitoring fields in 2000.

### Plans for Current Quarter (October-December 1999)

No activity scheduled until harvesting of the first crop grown on the soil-monitoring fields in 2000.

*If you have questions about the Expanded Monitoring Program, please contact Tracy Yager (see page 8). Commonly asked questions will be included in each Quarterly Report.*

## Definitions

*Alluvial aquifer*—Unconsolidated (uncemented) sediments and gravels in current or historic stream channels or floodplains that contain significant amounts of ground water

*Bedrock*—The rock that underlies soil or other uncemented materials

*Biosolids*—Solid organic matter recovered from a sewage-treatment process that meets regulatory criteria for beneficial use, such as for fertilizer. Metro District applies Grade I, Class B biosolids at Deer Trail. Regulations require that land-applied biosolids must meet or exceed Grade II, Class B. Grade I exceeds Grade II.

*Composited sample*—A sample made by combining individual samples (subsamples) into a single, larger sample. A composited sample might be prepared when a single individual sample is unlikely to be representative because of variable conditions.

*Inorganic*—Chemical elements and compounds that do not contain carbon atoms

*Radionuclides*—A radioactive atom characterized by a given number of neutrons and protons in its nucleus. For example, plutonium concentrations include plutonium-238 or plutonium-239, which are specific isotopes.

*Stakeholder*—Any person or group (including the Metro District) interested or concerned about the Expanded Monitoring Program

## Contacts

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Jim Crock, 303-236-2452

Metro District: Duane Humble, 303-286-3267

Elbert County: Mary Sue Liss, 303-621-3144

State Biosolids Coordinator: Lori Tucker, 303-692-3613

U.S. Environmental Protection Agency: Bob Brobst, 303-312-6129

*First annual stakeholder meeting was held July 15, 1999, in Kiowa, Colorado. Call Tracy Yager for more information.*

*Prepared by Tracy Yager, Dave Smith, and Jim Crock, November 1999*

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